Report Out

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You'll notice there are post-its on your chair. You can write any comments, feedback, criticisms for each team and place them on the appropriate spot. When we're done with the report out, each team will look at the comments and decide how to respond to them. You may choose to incorporate them or address the concerns.

Each team will have 8 minutes to report out your work.

Team 1 – Climate

We didn’t spend a lot of time on our science goals. We spent most of our time on our processes. We’re going from long-term single instruments to more short-term many measures.

In situ becomes our gold standard especially in terms of validation. Our key climate processes are listed here. We first brainstormed ideas and then organized them.

Our first number one priority here was water vapor and then we decided it was really reliable data.

We identified our timing. Short term is 4 years, midterm is 10 years and longterm is 20 years.

Here is our list of key parameters. We lumped them into 4 areas: a is 30km, b is 10km, c is 5km, d is 1km or less.

Our blob world shows where we think the low hanging fruit is. The gleam in our eye is where our science priorities are.

Team 1

1

CLIMATE

Science Goals

M3ab1

Time Scale

- long term ⟷ short term — ST
  - single measurements — many measure — ST
- ST
- decadal → centennial scale — ST, LT
  - + diurnal time scale for measurements — MT
- MT
- signatures on shorter timescale
- questions exist which can be answered with Seasonal campaigns — LT
- vertical temperature + humidity appear to be key parameters — MT, MT
- UAV should "fill in blanks" of global observation — ST, LT
  - ↳ synergy with ground and orbital systems
- validation of other data sources
  - ↳ in situ becomes "gold standard"
- Combined satellite experiments
- link to present + future satellite systems

1

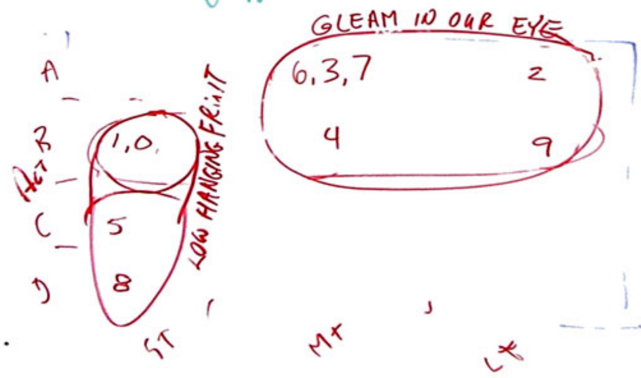
M3ab

SCIENCE PRIORITY Key Climate processes

(B) 15km (D) <1km

1 - water vapor (climate sensitivity) — 15 KM, TROPICS (B) SLOW CLIMB 4 KM, several/week 2-6 km
5 - carbon sources + sinks — 1 to multiple (C) 5000 km
8 - air-sea interaction — <1 km (D) 10.000 KM
0 - reliable data trend + validation — ST MULTIPLE POINT 0-16 KM (B) CLIMBER or Remote Sounder | LT GUPS (B)
6 - strat/trop — 20 km (D) 8 hours loiter — yearly campaigns
3 - climate sensitivity : solar flux : CO_2 — one solar cycle 30-40 KM (A) 8 hours regular repeats
9 - changes in dynamics — climber 0-16 km (B) regular repeats 2000 km
7 - ozone/climate interaction — (A) 30 km 2000 KM Short flight poles mid latitudes
4 - aerosol forcing — Climber 16 KM (B) Sample different regions
2 - anthropogenic vs. natural processes — ST 20K' 24 h CLIMBER (A) | LT REGIONAL NETWORKS

Short term - 4 years
Mid term - 10 years
Long term - 20+ years



Team 2 – Ocean and Surface Measurements

We focused on what UAVs can do that other things can't do. We ended up with the idea of studying response. That gives you a scale that is more appropriate to a UAV survey that you can start at any given point when things become interesting. You can get into a relatively small scale.

We looked at physical, chemical and biological responses to global change. Anything with ice and water we figured would be terribly important. It has a memory effect on gradients.

You have to make the measurements close to the surface. You have to fly low over the areas and measure the gases that come out: bromides, sulfur gases, methane, etc.

The biological response is interesting in terms of agriculture and anything having to do with marine research. This is a place where it's interesting to know detailed information for management.

Science begins with a differential equation.

Here are some detailed examples of applying this conceptual framework but this is not a complete list.

To understand coral bleaching you need to look at the microbes that live in symbiosis with the coral. Just like businesses, they do collaborate but they also have their own interests.

The enforcement question requires you know precisely what is going on.

Ocean and Surface Measurements

Telecmnections - Pacific Basin
Land - Sea - air

Science goals

Reefs / Coastal Conditions / Blooms

'chlorophyll

P patterns

management & control

pattern relationships

PDO

Patterns & controls on spatially explicit trace gas fluxes CO_2 / H_2O / N_2O / CH_4 Br S

only UAV

can then based Predicts future fluxes

volcano monitoring

Validate fluxes

forest fires

ice dynamics - role of polar ice sheets and sea level

ACTIVE SENSORS

Sea ice thickness & snow

temperate glacier thickness

Physics

Albedo

Ice

To predict

So. temp / Rif

Albedo

Climate

RATES

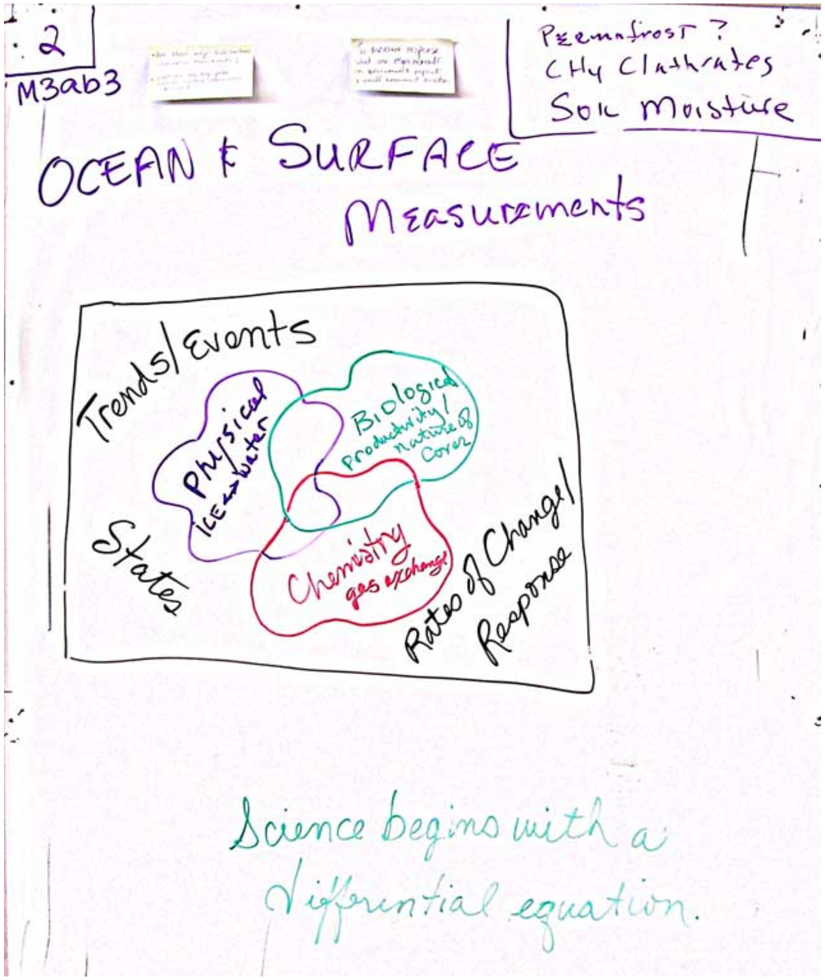
States

Chem & Trace gas

Biology

SCIENCE / operational GOAL	OBS
Patterns & Controls on spatially explicit trace gas fluxes (CO_2, H_2O, N_2O, CH_4, Br, S) for prediction & validation of future fluxes (carbon sequestration)	Low level insitu measurements of CO_2/etc. over ocean & land; flux + mass Flux; Wave height & form
	Exploratory - SOIL MOISTURE; Permafrost; Methane Clathrate; CH_4 flux
Sea level rise; ocean-Atmo-Ice interactions	Ice thickness; UAVs; Internal layers; Explorations - Sea Ice and Snow thickness; Surface Elevation
Baseline characterization of coral reef habitat in remote reserve areas	Hyperspectral imaging (targeted to special conditions or events) • Coral(s) locations • "Ghost" fishing net identification • Long range, remote locations
~~Ocean-ice-atmos fluxes - Albedo~~	~~Sea Ice thickness~~; ~~Snow thickness~~ - direct meas + UAVs only
Fisheries, Surveillance Enforcement in remote areas and reserve areas.	IR, visual optical Identifications
Monitoring of Natural hazards - Volcanoes, Earthquakes, floods	High spatial and temporal RS - Surface deformation - Soil moisture; UAVS only

Ocean and Surface Measurements



Rate of change / Response

$\boxed{2}$

M3ob2 (B)

JBR & CY

Need Collaboration to push to international/global scale

2) Without collab.
- not sustainable
- more costly
- lack of data quality & standards

3) needs standards & quality for long term observations (trend analysis, climate change)

4) Bring to bear new/latest technology (platforms) for meeting sci needs in
- rapid response
- unique
- new data (not achievable w/ current & "future" platforms)

Spectral

Precision

Surface ele

Roughness

Team 4 - Atmospheric Observations

Our most important science goal was to acquire observation on multiple levels. We decided not to list it because it was necessary for all of our goals. We also felt that the data needs to be research quality. The scientists need to be involved in it from the beginning.

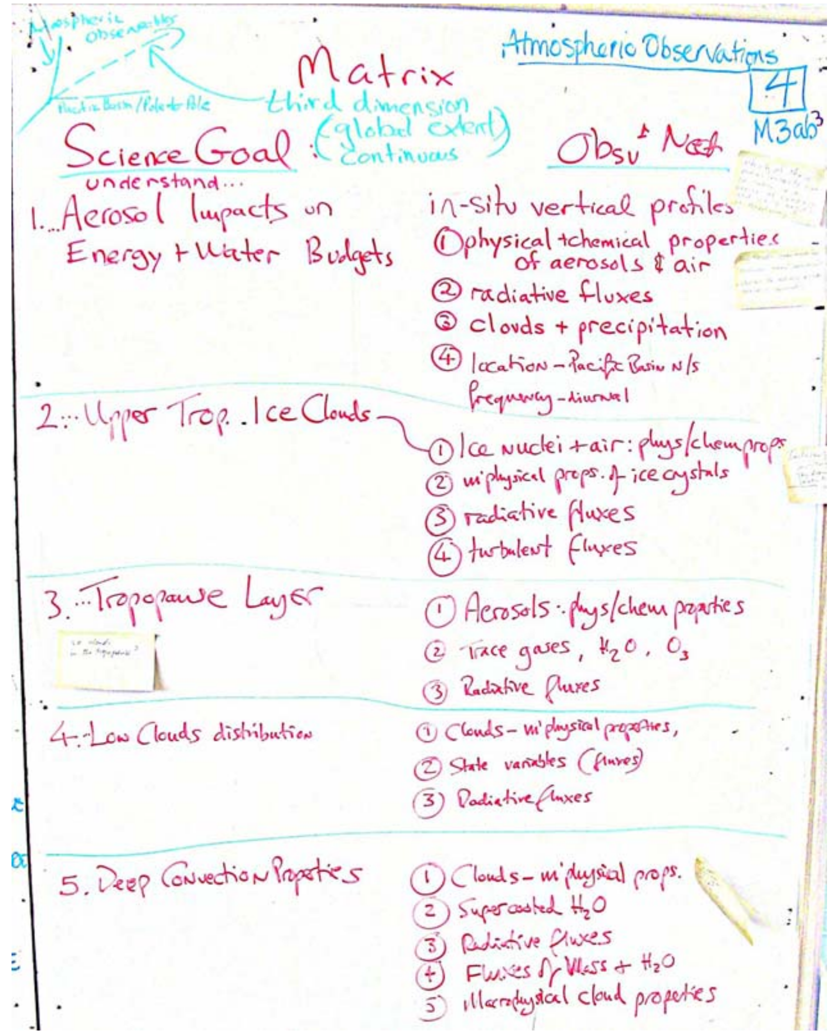
We made 5 science goals listed here with our observational needs.

We wanted to understand the aerosol impacts on energy and water budgets. In order to do that our identified observation need is the in-situ vertical profiles of various things.

In a gradient across the warm pool could give important types of information.

In our blob diagram, we tried to draw a 3d picture. We wanted to do pacific basin, or pole to pole, the 3rd is global oversation.

Everything is very closely related. Item 6 was the feedback system. This might be possible in the near term to make pole to pole gradients. Right now we can only get a projection on 2 dimensions but ultimately we need 3.



Atmospheric Observations

M3ab1

① Aerosol Impacts on Water + Energy Budgets
- radiative forcing, chemical compos^{n}s, size distb^{n}s, μphysics distb^{n}s
- impacts on clouds, rainfall and dynamics and vice-versa
- aerosol-cloud interactions
- elemental carbon + organics

#1 ② Long-term research quality space+time atmospheric obsv^{n}s to detect changes in $H_2O_{(v)}$, clouds, μphysics + multi-layered cloud cover, aerosols + ozone CO_2
- need for vertical profiles of all extinction, solar + ir Temp, Pressure, fluxes
- other variable chemical constituents

③ Upper tropospheric ~~clouds~~ (clouds /TW) ice
- understand ice nucleation
- chemical compos^{n} & physical consequences (effect on rad^{n})
- anvil microphysical properties, rel^{n} to deep convection aerosol properties and dynamic evol^{n}
- maintenance of tropopause (rel^{n} to cirrus, cooling rates, dynamics)

④ Stratosphere - Troposphere Exchange Tropopause Layer
- $H_2O_{(v)}$, O_3, aerosols

⑫ What controls distb^{n} of low clouds $\boxed{4}$ M3ab2

⑤ Properties of deep convection
- relation to μphysics/dynamics
- what controls distb^{n} of supercooled H_2O
- relation to b.l. convection
- scaling of convection & controls
- impacts on multi-layer cloud cover, radiative properties and energy transfer

⑥ Feedbacks

Team 3 – Global Observation

We collapsed our science goals to hypotheses. We came up with three of them and there is no priority.

The first one here is to target our capabilities into remote regions of stable atmospheres.

We want to be able to profile the aerosol cloud. We think this is a unique niche for the UAVs. It's a big gap right now that could probably only be filled by the UAVs. We need to do this regional in scale and global in nature.

We discussed the "why now" of the UAVs and we defined now as the next 5 years. There is an ideal opportunity to evaluate the use of UAVs, contribute to IPY and we have NASA's A train on the suite of aerosol, cloud and precipitation observations.

We talked about our blob diagram. At the heart of the overlap are the profiles.

In the second one, we put the profiles in context of the 4 dimensions. We looked at the unique role of UAVs. The satellite gives you comprehensive horizontal picture except for the penetration. If you take the best of the horizontal and add the vertical that can be done by the UAVs, we can get the best picture.

In the third circle here, we have what's sustained. The more spatially comprehensive part of the earth you can get is the most ideal observing system. Right now we only get 80%.

Global Observation

3

Science Goals

M3ab2

Value added is vague

1 * Improve weather predictions
(S) (BC) 1-14 days (JS) — adaptive obs →

2 * Observe extreme changes
#1 (Climate events like collapse of ice shelf)
(BC) 1

3 * Sampling Multi-scale processes

4 * AM (1) Detect slow changes of
(SAK) profiles state and forcing variables

5 (JS) * AM (2) Determine causes of observed changes
thru observational (key) signatures

6 * Better documentation of current 3D systems

7 * Particulates Profiles in non-clear atmosphere
in and below clouds
— Better understand aerosol particulate and cloud processes
(JS)
- in-situ
- large scale
- long duration
- systematic process studies
* aerosol water cycle

8 * Improve polar region (repeated) for FOV
(Lack of polar geostationary)

10-20 YR Climate FORECAST
Regional

3

M3ab3

Science Goals — Obs Need

A. Hyp: Targeted 'profiles' in remote sensitive regions of the atmosphere will contribute to significant improvements in short → medium range Wx forecasts (within the framework of existing capabilities)

enhancement over existing

* Adaptive observing system able to access remote regions to take detailed all weather soundings

B. Hyp: Sustained measurements of Profiles of atmospheric composition, state and bulk fluxes will contribute to significant improvements in detection of climate change & the attribution of climate change

* Systematic, high quality, all weather soundings; large scale;

C Hyp: Large scale variations of aerosol induce large-scale changes in the water cycle

requires in situ profiling
- large-scale, systematic process studies → profiles of the potential atmosphere (aerosol, cloud, + chemistry) precipitation

Comments

I'm surprised of the degree of similarity between the groups. It seems that there is a lot of overlap. We heard a lot about profiling. All the groups thought about what is unique about UAVs and came up with similar ideas.

It is clear that all these areas intersect or are identical.

There is a fundamental problem in the measurement. We realize that we need more information or detail here or there. On the other hand, if we want sustained measurements, you have to make up your mind ahead of time where you're going to put substantial resources. I see a lot of discussion in sorting out our needs as our learning curve gets better.

This is so valuable. We need to do this in an inclusive way to be successful in this stage.

Anybody who has tried to answer the question of trends knows that we don't have an answer even though we've been monitoring for 5 decades. There are some very big questions about how we're going to do the vertical platform. Most likely we're going to have to do both. With modern technology
You have to have a continuous research presence and to maintain the quality control. There is a big constituency involved. It's the politicians' job to make us answer to that. They really have a bottom up orientation.

We have to concentrate the global perspective on one fleet of the UAVs.

It is both. We're still learning to measure water well. We don't want to squelch one side for the other.

We need to have multiple platforms available and they need to be affordable. We need to have the entrepreneurial form so that we can have access to all the modalities.

You have to be sure the UAVs are up to the task. If you're committing to a 20-year mission, you need to make sure you can afford the maintenance on that UAV.

If you can get the cost down so that you can incorporate the sensor packages in a more elaborate system than just dropping, that includes better access to climate information, that would be more useful.

Langdon

Go back to your teams, incorporate the feedback and pick out 3 science goals that you want to develop further. Clarify these four areas:

- Science Goal
- Observational Needs
- Societal Benefits
- UAV uses

Each team will have 3 goals articulated. Each individual will have the chance then to vote for which they think is the best one with which to follow through.

If we can do it in two years we don't need an initiative. We should follow through with something that everybody thinks is worthy and is tractable. Initiatives get sold on being sure-fire things that will succeed.

We have our A-level people concurring that we will continue on.